

What is claimed is:

1. An apparatus for calcining gypsum comprising:
 - a housing having an open top, a bottom wall, and a plurality of side walls extending therebetween;
 - a fixture located on the housing for receiving raw gypsum from a source and transferring the gypsum into the housing;
 - a support floor positioned proximate the bottom wall for holding the gypsum in the housing;
 - at least one burner connected to the housing and operable for combusting an air/fuel mixture to heat the gypsum; and
 - at least one serpentine burner conduit extending through the housing from the at least one burner and terminating through the support floor.
2. The apparatus of claim 1, wherein the burner conduit includes an initial linear section extending from the burner.
3. The apparatus of claim 1, wherein the burner conduit includes at least one reduced diameter section to provide increased flow velocity and enhanced heat transfer effectiveness.
4. The apparatus of claim 1, wherein the burner conduit further comprises:
 - a plurality of relatively smaller diameter conduits forming at least one multi conduit portion of the burner conduit, the at least one multi conduit portion constructed to be in fluid communication with the relatively larger diameter conduit.
5. The apparatus of claim 1, wherein the support floor comprises:
 - a fluidization base for receiving the exhaust flow from the burner conduit.
6. The apparatus of claim 5, further comprising:
 - a fluidization pad positioned above the fluidization base, the fluidization pad at least partially forming the support floor for holding the gypsum

and being operable for controlling and distributing the exhaust flow from the fluidization base into the gypsum.

7. The apparatus of claim 6, wherein the fluidization pad comprises:

first and second outer perforated plates; and
at least one intermediate layer of material positioned between the outer plates.

8. The apparatus of claim 7, wherein the intermediate layer of material is a porous media made from one of a compressed silica fiber and a woven stainless steel mesh.

9. The apparatus of claim 7, wherein the perforated plates are made from metal.

10. The apparatus of claim 6, wherein the fluidization pad comprises:

a porous media material.

11. The apparatus of claim 10, wherein the porous media is made from one of a compressed silica fiber and a woven stainless steel mesh.

12. The apparatus of claim 1, further comprising:
an agitation mechanism operable for preventing fluid channeling and preventing dead pockets of gypsum from forming adjacent the support floor.

13. The apparatus of claim 12, wherein the agitation mechanism includes an agitator frame.

14. The apparatus of claim 13, wherein the agitation mechanism includes a plurality of agitation members connected to the agitator frame for agitating the gypsum adjacent the support floor when the agitator frame moves.

15. The apparatus of claim 13, wherein the agitation mechanism includes at least one pivotable support arm for pivotally connecting the agitator frame to the apparatus.

16. The apparatus of claim 15, wherein the at least one pivotable support arm is a cable pivotally attached to the calcining apparatus at one end and to the agitator frame at the other end, wherein the agitator frame will swing about a pivot axis when motion is imparted thereto.

17. The apparatus of claim 13, wherein the agitation mechanism includes a power source to move the agitator frame.

18. The apparatus of claim 17, wherein the power source includes one of an electric motor and a pneumatic actuator.

19. The apparatus of claim 18, further comprising:

an actuator arm extending through the housing to provide a connection between the motor and the agitator frame.

20. The apparatus of claim 19, wherein the agitation mechanism further comprises:

an expandable seal engaged with the actuator arm and the housing to prevent gypsum from leaking from the housing.

21. The apparatus of claim 20, wherein the seal expands and contracts as the actuator arm moves between first and second positions.

22. The apparatus of claim 13, wherein the agitator frame moves in one of: a horizontal, a vertical, and an arcuate pattern.

23. The apparatus of claim 1, further comprising:

an overflow tube in fluid communication with the apparatus to allow processed gypsum to egress out of the apparatus.

24. The apparatus of claim 23, further comprising:

an overflow valve associated with overflow tube to prevent gypsum from egressing from the apparatus before being heated to a predetermined condition.

25. The apparatus of claim 1, further comprising:

a dump port having a dump valve for permitting selective draining of the housing.

26. The apparatus of claim 1, further comprising:

an exhaust stack connected to the apparatus for exhausting combustion gas from the apparatus.

27. The apparatus of claim 1, further comprising:

a conduit support slideably connected to the apparatus for supporting the burner conduit during installed and uninstalled positions, the conduit support movable between a first position internal to the housing and a second position at least partially external to the housing for supporting the conduit during installation and removal from the housing.

28. The apparatus of claim 27, wherein the conduit support comprises:

a pair of beams slideably connected to parallel walls of the apparatus;
and

a plurality of cross bars extending between the beams being engageable with the burner conduit.

29. The apparatus of claim 1, further comprising:

at least one access panel located on the housing for servicing internal components thereof.

30. The apparatus of claim 1, further comprising:

a disengagement chamber positioned adjacent the open top of the housing, the disengagement chamber having at least one door to permit access therein.

31. The apparatus of claim 1, further comprising:

a dust collector for collecting gypsum dust particles and recycling the particles back to the housing.

32. The apparatus of claim 31, wherein the dust collector includes a plurality of filters.

33. The apparatus of claim 32, wherein the filters are cleaned by intermittently injecting air through an opposing side of where the dust is collected.

34. The apparatus of claim 1, wherein the burner conduit includes a section having at least one through aperture to permit exhaust flow to exit therefrom directly into the gypsum.

35. An apparatus for calcining gypsum comprising:

a housing having an open top, a bottom wall, and a plurality of side walls extending therebetween;

a fixture connected to the housing for receiving raw gypsum from a source and transferring the gypsum into the apparatus;

at least one burner connected to a side wall and operable for combusting an air/fuel mixture to heat the gypsum;

at least one burner conduit extending from the at least one burner, the conduit passing in heat exchange relationship with the gypsum and discharging exhaust flow into the gypsum causing fluidization thereof; and

an agitation mechanism operable for preventing fluid channeling and dead pockets of gypsum adjacent the bottom wall.

36. The apparatus of claim 35, wherein the burner conduit includes a substantially straight section extending from the burner.

37. The apparatus of claim 35, wherein the burner conduit includes at least one reduced diameter section to provide increased flow velocity and enhanced heat transfer effectiveness.

38. The apparatus of claim 35, wherein the burner conduit further comprises:

a plurality of relatively smaller diameter conduits forming at least one multi conduit portion of the burner conduit, the at least one multi conduit portion constructed to be in fluid communication with the relatively larger diameter conduit.

39. The apparatus of claim 35, further comprising:

a fluidization base for receiving the exhaust flow from the burner conduit.

40. The apparatus of claim 39, further comprising:

a fluidization pad positioned above the fluidization base, the fluidization pad forming a floor for holding the gypsum and is operable for controlling and distributing the exhaust flow into the gypsum.

41. The apparatus of claim 40, wherein the fluidization pad comprises:

first and second outer perforated plates; and

at least one intermediate layer of material positioned between the outer plates.

42. The apparatus of claim 41, wherein the intermediate layer of material is a porous media made from compressed silica fiber.

43. The apparatus of claim 41, wherein the perforated plates are made from metal.

44. The apparatus of claim 35, wherein the agitation mechanism includes an agitator frame.

45. The apparatus of claim 44, wherein the agitation mechanism includes a plurality of agitation members connected to the agitator frame for agitating the gypsum adjacent the bottom wall when the agitator frame moves.

46. The apparatus of claim 44, wherein the agitation mechanism includes at least one pivotable support arm for pivotally connecting the agitator frame to the apparatus.

47. The apparatus of claim 46, wherein the at least one pivotable support arm is a cable pivotally attached to the calcining apparatus at one end and to the agitator frame at the other end, wherein the frame will swing about a pivot axis when motion is imparted thereto.

48. The apparatus of claim 35, wherein the agitation mechanism includes a power source to move the agitator frame.

49. The apparatus of claim 48, wherein the power source includes one of an electric motor and a pneumatic actuator.

50. The apparatus of claim 48, further comprising:

an actuator arm extending through the housing to provide a connection between the power source and the agitator frame.

51. The apparatus of claim 50, wherein the agitation mechanism further comprises:

an expandable seal engaged with the actuator arm and the housing to prevent gypsum from leaking from the housing.

52. The apparatus of claim 51, wherein the seal expands and contracts as the actuator arm moves between first and second positions.

53. The apparatus of claim 35, further comprising:

an overflow tube in fluid communication with the apparatus to allow processed gypsum to egress out of the apparatus.

54. The apparatus of claim 53, further comprising:

an overflow valve associated with overflow tube to prevent gypsum from egressing from the apparatus before being heated to a predetermined condition.

55. The apparatus of claim 35, further comprising:

a dump port having a dump valve for permitting selective draining of the housing.

56. The apparatus of claim 35, further comprising:

an exhaust stack connected to the apparatus for exhausting combustion gas from the apparatus.

57. The apparatus of claim 35, further comprising:

a conduit support having a pair of side rails slideably connected to parallel walls of the apparatus; and

a plurality of cross bars extending between the side rails engageable with the burner conduit for supporting the burner conduit during installed and uninstalled positions, the support movable between a first position internal to the housing and a second position at least partially external to the housing for supporting the conduit during installation and removal from the housing.

58. The apparatus of claim 35, further comprising:

at least one access panel located on the housing for servicing internal components thereof.

59. The apparatus of claim 35, further comprising:

a disengagement chamber positioned adjacent the open top of the housing, the disengagement chamber having at least one door to permit access therein.

60. The apparatus of claim 35, further comprising:

a dust collector for collecting gypsum dust particles and recycling the particles back to the apparatus.

61. The apparatus of claim 60, wherein the dust collector includes a plurality of filters.

62. The apparatus of claim 61, wherein the filters are cleaned by intermittently injecting air through an opposing side of where the dust is collected.

63. The apparatus of claim 35, wherein the burner conduit includes a section having at least one through aperture to permit exhaust flow to exit therefrom directly into the gypsum.

64. The apparatus of claim 35, wherein the burner conduit is formed in a generally serpentine shape.

65. The apparatus of claim 35, wherein the housing includes a generally rectangular cross-section.

66. The apparatus of claim 65, wherein a length of the cross-section is approximately sixteen feet.

67. The apparatus of claim 35, wherein the burner conduit includes a plurality of conduits positioned adjacent one another, the number of conduits being proportional to a width of the housing.

68. A method for calcining gypsum comprising the steps of:

providing gypsum to a calcining apparatus;

heating the gypsum with a serpentine burner via conduction heat transfer with a conduit extending from an external burner through the gypsum and terminating at a bottom wall of the apparatus;

flowing the exhaust gas through a fluidization pad; and

fluidizing and further heating the gypsum via convection heat transfer by flowing substantially all of the exhaust gas through the gypsum.

69. The method of 68, further comprising:

opening an overflow valve to permit the fluidized gypsum to egress therethrough when the gypsum reaches approximately 300 degrees Fahrenheit.

70. The method of 68, further comprising:

removing and churning stagnant portions of gypsum adjacent the bottom wall with an agitation mechanism.